

Course Outline (F2023)

EES612: Electrical Machines and Actuators

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|---|---|
| Instructor(s) | Dr. Richard Cheung [Coordinator] Office: ENG330 Phone: (416) 979-5000 x 556112 Email: cheung@torontomu.ca Office Hours: Fridays 8am-9am, 12pm-1pm |
| Calendar Description | The single-phase transformer and its applications. DC and AC motor characteristics, and their application in mechanical drives. Power electronic circuits, H bridges, PWM control, interfacing, power amplifiers. DC servo and stepper motors, AC synchronous and induction motors. Transformers. Introduction to typical speed and torque control techniques of motors. |
| Prerequisites | CEN 199 and (EES 512 or ELE 202) |
| Antirequisites | None |
| Corerequisites | None |
| Compulsory Text(s): | <ol style="list-style-type: none"> Allan R. Hambley, Electrical Engineering: Principles and Applications, Pearson, 2017, ISBN: 978-0-13-448414-3 eText: Electrical Engineering: Principles & Applications, Student Value Edition Plus Mastering Engineering with Pearson eText Access Card Package, 7/E, Allan R. Hambley, 2017, Pearson ISBN-10: 0134702190, ISBN-13: 9780134702193 |
| Reference Text(s): | <ol style="list-style-type: none"> Ned Mohan, Electric Drives an Integrative Approach, Minpere, 2003, ISBN: 0-9715292-5-6 |
| Learning Objectives (Indicators) | <p>At the end of this course, the successful student will be able to:</p> <ol style="list-style-type: none"> Develop further knowledge of electricity and magnetism in support of applications to electric machinery problems. (1c) Use models to solve electric machinery problems and understand limitations of the electric machine models. (2b) Compare theoretical values with experimental values, to characterize the accuracy of the electric machine models and understand their limitations. (3a) Calculate the parameters of the electric machines studied and their behavior under various loading conditions. (4b) Verify and validate experimental results, using the established theories and laws of electromagnetic and physics. (5b) <p>NOTE: Numbers in parentheses refer to the graduate attributes required by the Canadian Engineering Accreditation Board (CEAB).</p> |
| Course Organization | 3.0 hours of lecture per week for 13 weeks 2.0 hours of lab per week for 12 weeks |

| | 0.0 hours of tutorial per week for 12 weeks | | | | | | | | | | | | |
|-------------------------------------|---|---------------|--|---------------|------|------------|------|-------------------|--|------|------|--------|-------|
| Teaching Assistants | TBA | | | | | | | | | | | | |
| Course Evaluation | <table border="1"> <thead> <tr> <th colspan="2">Theory</th> </tr> </thead> <tbody> <tr> <td>Mid Term Exam</td> <td>20 %</td> </tr> <tr> <td>Final Exam</td> <td>46 %</td> </tr> <tr> <th colspan="2">Laboratory</th> </tr> <tr> <td>Labs</td> <td>34 %</td> </tr> <tr> <td>TOTAL:</td> <td>100 %</td> </tr> </tbody> </table> <p>Note: In order for a student to pass a course, a minimum overall course mark of 50% must be obtained. In addition, for courses that have both "Theory and Laboratory" components, the student must pass the Laboratory and Theory portions separately by achieving a minimum of 50% in the combined Laboratory components and 50% in the combined Theory components. Please refer to the "Course Evaluation" section above for details on the Theory and Laboratory components (if applicable).</p> | Theory | | Mid Term Exam | 20 % | Final Exam | 46 % | Laboratory | | Labs | 34 % | TOTAL: | 100 % |
| Theory | | | | | | | | | | | | | |
| Mid Term Exam | 20 % | | | | | | | | | | | | |
| Final Exam | 46 % | | | | | | | | | | | | |
| Laboratory | | | | | | | | | | | | | |
| Labs | 34 % | | | | | | | | | | | | |
| TOTAL: | 100 % | | | | | | | | | | | | |
| Examinations | Midterm exam on October 24, 2023, three hours (3:00 pm-6:00 pm), closed book. Final exam, during the exam period, three hours, closed book. | | | | | | | | | | | | |
| Other Evaluation Information | | | | | | | | | | | | | |
| Teaching Methods | The lectures are delivered in person at ENG103 Tuesday 3:00 pm-6:00 pm Labs sessions are in person at ENG309. | | | | | | | | | | | | |
| Other Information | None | | | | | | | | | | | | |

Course Content

| Week | Hours | Chapters / Section | Topic, description |
|-------|-------|--------------------|--|
| 1,2,3 | 9 | 14 | Magnetic Circuits & Transformers: <ul style="list-style-type: none"> - Magnetic fields - Magnetic circuits - Inductances - Magnetic Materials - Ideal transformers - Practical (real) transformers - Circuit model of a real transformer and approximate models |

| | | | |
|-------|---|-------------|--|
| | | | <ul style="list-style-type: none"> - Open-circuit and short-circuit tests for determination of circuit parameters - Voltage regulation and efficiency |
| 4,5 | 6 | 15 | <p>DC Machines:</p> <ul style="list-style-type: none"> - Overview of motors - Principles of DC machines - Rotating DC machines - Separately excited, shunt-connected, series-connected DC motors - Control of DC motors |
| 6,7,8 | 9 | 16 | <p>AC Machines:</p> <ul style="list-style-type: none"> - Three-phase induction motors - Equivalent-circuit & performance calculations for induction motors - Synchronous machines - Single-phase motors |
| 9,10 | 6 | Class Notes | <p>Power Electronics & Motor Drives:</p> <ul style="list-style-type: none"> - Power electronic circuits - H-bridge controls - PWM controls - Stepper motor drives - Brushless DC motor drives |
| 11,12 | 6 | Class Notes | <p>Electric Actuators:</p> <ul style="list-style-type: none"> - Basic operations of electric actuators - Design of electric actuators - Electric actuator performance - Variable speed drives for electric actuators - Fail-safe functionality of various actuators - Electric actuator setup, control, and monitoring |
| 13 | 3 | Class Notes | Review |

Laboratory(L)/Tutorials(T)/Activity(A) Schedule

| Week | L/T/A | Description |
|------|-------|-------------|
|------|-------|-------------|

| | | |
|---|---|--------------------------------------|
| 1 | L | Lab Preparation |
| 2 | L | Lab 1: Transformers |
| 1 | L | Lab Test 1: Transformers |
| 2 | L | Lab 2: DC Motors |
| 1 | L | Lab Test 2: DC Motors |
| 2 | L | Lab 3: AC Motors |
| 1 | L | Lab Test 3: AC Motors |
| 2 | L | Lab 4: Power electronic motor drives |

University Policies

Students are reminded that they are required to adhere to all relevant university policies found in their online course shell in D2L and/or on [the Senate website](#)

Important Resources Available at Toronto Metropolitan University

- [The Library](#) provides research [workshops](#) and individual assistance. If the University is open, there is a Research Help desk on the second floor of the library, or students can use the [Library's virtual research help service](#) to speak with a librarian.
- [Student Life and Learning Support](#) offers group-based and individual help with writing, math, study skills, and transition support, as well as [resources and checklists to support students as online learners](#).
- You can submit an [Academic Consideration Request](#) when an extenuating circumstance has occurred that has significantly impacted your ability to fulfill an academic requirement. You may always visit the [Senate website](#) and select the blue radio button on the top right hand side entitled: Academic Consideration Request (ACR) to submit this request.

For Extenuating Circumstances, Policy 167: Academic Consideration allows for a once per semester ACR request without supporting documentation if the absence is less than 3 days in duration and is not for a final exam/final assessment. Absences more than 3 days in duration and those that involve a final exam/final assessment, require documentation. Students must notify their instructor once a request for academic consideration is submitted. See Senate [Policy 167: Academic Consideration](#).

- If taking a remote course, familiarize yourself with the tools you will need to use for remote learning. The [Remote Learning Guide](#) for students includes guides to completing quizzes or exams in D2L Brightspace, with or without [Respondus LockDown Browser and Monitor, using D2L Brightspace](#), joining online meetings or lectures, and collaborating with the Google Suite.
- Information on Copyright for [Faculty](#) and [students](#).

Accessibility

- Similar to an [accessibility statement](#), use this section to describe your commitment to making this course accessible to students with disabilities. Improving the accessibility of your course helps minimize the need for accommodation.
- Outline any technologies used in this course and any known accessibility features or barriers (if applicable).
- Describe how a student should contact you if they discover an accessibility barrier with any course materials or technologies.

Academic Accommodation Support

Academic Accommodation Support (AAS) is the university's disability services office. AAS works directly with incoming and returning students looking for help with their academic accommodations. AAS works with any student who requires academic accommodation regardless of program or course load.

- Learn more about [Academic Accommodation Support](#).
- Learn [how to register with AAS](#).

Academic Accommodations (for students with disabilities) and Academic Consideration (for students faced with extenuating circumstances that can include short-term health issues) are governed by two different university policies. Learn more about [Academic Accommodations versus Academic Consideration and how to access each](#).

Wellbeing Support

At Toronto Metropolitan University, we recognize that things can come up throughout the term that may interfere with a student's ability to succeed in their coursework. These circumstances are outside of one's control and can have a serious impact on physical and mental well-being. Seeking help can be a challenge, especially in those times of crisis.

If you are experiencing a mental health crisis, please call 911 and go to the nearest hospital emergency room. You can also access these outside resources at anytime:

- **Distress Line:** 24/7 line for if you are in crisis, feeling suicidal or in need of emotional support (phone: 416-408-4357)
- **Good2Talk:** 24/7-hour line for postsecondary students (phone: 1-866-925-5454)
- **Keep.meSAFE:** 24/7 access to confidential support through counsellors via [My SSP app](#) or 1-844-451-9700

If non-crisis support is needed, you can access these campus resources:

- **Centre for Student Development and Counselling:** 416-979-5195 or email csdc@torontomu.ca
- **Consent Comes First - Office of Sexual Violence Support and Education:** 416-919-5000 ext 3596 or email osvse@torontomu.ca
- **Medical Centre:** call (416) 979-5070 to book an appointment

We encourage all Toronto Metropolitan University community members to access available resources to ensure support is reachable. You can find more resources available through the [Toronto Metropolitan University Mental Health and Wellbeing](#) website.